

## AP CHEMISTRY REVIEW BINDING FORCES

1. Solid camphor is insoluble in water but is soluble in vegetable oil. The best explanation for this behavior is that camphor is a(n)  
(A) ionic solid (B) metallic solid (C) molecular solid (D) network solid
2. Moist air is less dense than dry air at the same temperature and barometric pressure. Which is the best explanation for this observation?  
(A)  $\text{H}_2\text{O}$  is a polar molecule but  $\text{N}_2$  and  $\text{O}_2$  are not.  
(B)  $\text{H}_2\text{O}$  has a higher boiling point than  $\text{N}_2$  or  $\text{O}_2$ .  
(C)  $\text{H}_2\text{O}$  has a lower molar mass than  $\text{N}_2$  or  $\text{O}_2$ .  
(D)  $\text{H}_2\text{O}$  has a higher heat capacity than  $\text{N}_2$  or  $\text{O}_2$ .
3. The removal of an electron from which gaseous atom requires the greatest amount of energy?  
(A) Na (B) Cl (C) K (D) Br
4. For which pair of species is the difference in radii the greatest?  
(A) Li and F (B)  $\text{Li}^+$  and  $\text{F}^-$  (C)  $\text{Li}^+$  and  $\text{O}_2^-$  (D)  $\text{O}^{2-}$  and  $\text{F}^-$
5. Which element has the greatest electrical conductivity?  
(A) As (B) Ge (C) P (D) Sn
6. When the compounds HF,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ , and  $\text{CH}_4$  are listed in order of increasing boiling point, which order is correct?  
(A)  $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O} < \text{HF}$   
(B)  $\text{NH}_3 < \text{CH}_4 < \text{H}_2\text{O} < \text{HF}$   
(C)  $\text{HF} < \text{CH}_4 < \text{H}_2\text{O} < \text{NH}_3$   
(D)  $\text{CH}_4 < \text{NH}_3 < \text{HF} < \text{H}_2\text{O}$
7. Which ionic solid has the greatest lattice energy?  
(A) NaCl (B) MgO (C) KBr (D) SrS
8. Solid sodium acetate,  $\text{NaC}_2\text{H}_3\text{O}_2$ , is what type of solid?  
(A) ionic (B) metallic (C) molecular (D) network covalent
9. Which substance has the highest vapor pressure at  $25^\circ\text{C}$ ?  
(A) methanol,  $\text{CH}_3\text{OH}$   
(B) ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$   
(C) 1-propanol,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
(D) 1-butanol,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
10. I. dipole-dipole forces  
II. hydrogen bonding  
III. London dispersion forces

What types of intermolecular forces are exerted by  $\text{CH}_3\text{Cl}$  molecules in the liquid phase?  
(A) I only (B) II only (C) I and III only (D) II and III only

11. Which electronic transition in a hydrogen atom releases the greatest amount of energy?  
(A)  $n = 3 \rightarrow n = 2$  (B)  $n = 5 \rightarrow n = 3$  (C)  $n = 6 \rightarrow n = 5$  (D)  $n = 3 \rightarrow n = 6$

12. Which pair consists of species that are isoelectronic?  
(A)  $\text{Na}^+$ ,  $\text{K}^+$  (B)  $\text{Cl}$ ,  $\text{Cl}^-$  (C)  $\text{Fe}^{2+}$ ,  $\text{Mn}^{2+}$  (D)  $\text{Ar}$ ,  $\text{Ca}^{2+}$
13. In which series are the species listed in order of increasing size?  
(A)  $\text{N}$ ,  $\text{O}$ ,  $\text{F}$  (B)  $\text{Na}$ ,  $\text{Mg}$ ,  $\text{K}$  (C)  $\text{Cr}$ ,  $\text{Cr}^{2+}$ ,  $\text{Cr}^{3+}$  (D)  $\text{Cl}$ ,  $\text{Cl}^-$ ,  $\text{S}^{2-}$
14. Which substance has the highest melting point?  
(A)  $\text{CO}$  (B)  $\text{CO}_2$  (C)  $\text{SiO}_2$  (D)  $\text{P}_2\text{O}_5$
15. All of these are characteristics of MOST ionic compounds in the solid phase EXCEPT  
(A) high electrical conductivity  
(B) high melting point  
(C) solubility in water  
(D) insolubility in organic solvents
16. Rank the enthalpies of fusion, sublimation and vaporization for water.  
(A) sublimation = vaporization = fusion  
(B) vaporization < sublimation < fusion  
(C) fusion < sublimation < vaporization  
(D) fusion < vaporization < sublimation
17. All of the following properties of liquids increase with increasing strengths of intermolecular forces EXCEPT  
(A) boiling point (B) enthalpy of vaporization (C) vapor pressure (D) viscosity
18. Which substance has both covalent and ionic bonds?  
(A)  $\text{NH}_4\text{Br}(\text{s})$  (B)  $\text{KI}(\text{s})$  (C)  $\text{CH}_2\text{Cl}_2(\text{l})$  (D)  $\text{SiF}_4(\text{g})$
51. Which has the largest bond dissociation energy?  
(A)  $\text{H-F}$  (B)  $\text{H-Cl}$  (C)  $\text{H-Br}$  (D)  $\text{H-I}$
19. Which is the electron configuration for an  $\text{Fe}(\text{III})$  ion in its ground state?  
(A)  $[\text{Ar}] 3\text{d}^5$  (B)  $[\text{Ar}] 3\text{d}^6$  (C)  $[\text{Ar}] 4\text{s}^2 3\text{d}^3$  (D)  $[\text{Ar}] 4\text{s}^2 3\text{d}^6$
20. What is the most effective way to condense a gas?  
(A) Decrease the temperature and increase the pressure.  
(B) Decrease the temperature and decrease the pressure.  
(C) Increase the temperature and decrease the pressure.  
(D) Increase the temperature and increase the pressure.
21. Which liquid has the highest vapor pressure at  $25^\circ\text{C}$ ?  
(A) butane,  $\text{C}_4\text{H}_{10}$  (B) glycerol,  $\text{C}_3\text{H}_5(\text{OH})_3$  (C) octane,  $\text{C}_8\text{H}_{18}$  (D) propanol,  $\text{C}_3\text{H}_7\text{OH}$
22. Which oxide has the highest melting point?  
(A)  $\text{H}_2\text{O}$  (B)  $\text{NO}_2$  (C)  $\text{SO}_2$  (D)  $\text{SiO}_2$
23. An monoatomic ion that has 18 electrons and a +2 charge  
(A) has 16 protons. (B) has the symbol  $\text{Ar}^{2+}$ . (C) has 18 neutrons. (D) is isoelectronic with  $\text{Ar}$ .

24. Which atom has the largest atomic radius?

(A) Li (B) K (C) As (D) Br

25. The boiling points of the halogens,  $F_2$ ,  $Cl_2$ ,  $Br_2$  and  $I_2$ , increase in that order. This is best attributed to differences in

(A) covalent bond strengths.

(B) dipole forces.

(C) London dispersion forces.

(D) colligative forces.

26. Which species is polar?

(A)  $CO_2$  (B)  $SO_2$  (C)  $SO_3$  (D)  $O_2$

27 The lowest melting points overall occur for members of which class of solids?

(A) ionic (B) metallic (C) molecular (D) network covalent

28 What are the strongest intermolecular force between neighboring carbon tetrachloride,  $CCl_4$ , molecules?

(A) dipole-dipole forces (B) dispersion forces (C) hydrogen bonds (D) covalent bonds

29. Which atom has the smallest first ionization energy?

(A) Na (B) K (C) Mg (D) Ca

30. When the atoms; P ( $Z = 15$ ), S ( $Z = 16$ ) and As ( $Z = 33$ ), are arranged in order of increasing radius, what is the correct order?

(A) P, S, As (B) As, S, P (C) S, P, As (D) P, As, S

31. The oxide of which element is the most ionic?

(A) Al (B) B (C) C (D) Si

33. All of the following lists include at least one ionic compound EXCEPT

(A)  $NO_2$ ,  $NaNO_2$ ,  $KNO_3$  (B)  $CF_4$ ,  $CaF_2$ , HF (C)  $NaCl$ ,  $MgCl_2$ ,  $SCl_2$  (D)  $H_2S$ ,  $SO_2$ ,  $SF_6$

34. Which diatomic molecule has the shortest bond length?

(A)  $N_2$  (B)  $O_2$  (C)  $F_2$  (D)  $S_2$

35. Which species is nonpolar?

(A) HCl (B)  $OCl_2$  (C)  $NCl_3$  (D)  $CCl_4$

36. Which substance contains individual molecules in the solid?

(A) graphite (B) iodine (C) mercury (D) silicon carbide

37. The compounds  $C_3H_8$ ,  $CH_3CH_2OH$ , and  $CH_3OCH_3$  have very similar molar masses. When they are arranged in order of *increasing* strength of their intermolecular forces, what is the correct order?

(A)  $C_3H_8$ ,  $CH_3OCH_3$ ,  $CH_3CH_2OH$

(B)  $CH_3CH_2OH$ ,  $CH_3OCH_3$ ,  $C_3H_8$

(C)  $CH_3OCH_3$ ,  $C_3H_8$ ,  $CH_3CH_2OH$

(D)  $CH_3CH_2OH$ ,  $C_3H_8$ ,  $CH_3OCH_3$

38. Which property does *not* indicate strong intermolecular forces?  
 (A) high enthalpy of vaporization  
 (B) high viscosity  
 (C) high critical temperature  
 (D) high vapor pressure
39. Which property decreases from left to right across the periodic table and increases from top to bottom?  
 (A) atomic radius (B) electronegativity (C) ionization energy (D) melting point
40. Which has the highest ionization energy for the removal of the *second* electron?  
 (A) F (B) Ne (C) Na (D) Mg
41. Which pair of elements have chemical properties that are the most similar?  
 (A) Be and B (B) Al and Ga (C) Co and Cu (D) F and I

Key

2010

1- 4. C

2- 16. C

3- 45. B

4- 46. C

5- 48. D

6- 53. D

7- 54. B

2009

8- 15. A

9-16. A

10-18. C

11-44. A

12-47. D

13-48. D

14-52. C

2007

15-13. A

16-15. D

17-18. C

18-50. A

51 A

19-48. A

2004

20- 16. A

21- 17. A

22-18. D

23-45. D

24-46. B

25-53. C

26-54. B

2003

27-18. C

28-19. B

29-45. B

30-47. C

31-48. A

33-49. D

34-52. A

35-53. D

2002

36-19. B

37-20. A

38-21. D

39-47. A

40-49. C

41-50. B